UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EXPOSURE RESEARCH LABORATORY
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OFFICE OF
RESEARCH AND DEVELOPMENT

April 17, 2019

Ken Kloo, Director
NJ Department of Environmental Protection
Division of Remediation Management
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Subject: NJ DEP Data Report #3: Targeted Analysis of PFAS in Water Samples

Dear Mr. Kloo:

I am pleased to provide you with the attached laboratory report that includes targeted analysis results for per- and polyfluoroalkyl substance (PFAS) concentrations in water samples. This is the third in a series of reports prepared as a part of EPA Office of Research and Development's (ORD) collaboration with the New Jersey Department of Environmental Protection (NJ DEP) and EPA Region 2 on the study, "Detection, Evaluation, and Assignment of Multiple Poly- and Perfluoroalkyl Substances (PFAS) in Environmental Media from an Industrialized Area of New Jersey." This report includes concentration results for 10 PFAS in 57 water samples and 25 field quality control samples. The ORD Principal Investigators (PIs) for this study are Drs. Andy Lindstrom, Mark Strynar, and John Washington. The results for this particular report were generated under the direction of Dr. Mark Strynar in our Research Triangle Park, NC laboratory. It is my understanding that these samples were collected by NJ DEP between October 17, 2017 and December 7, 2017 from surface water and wells from various locations in the vicinity of the Solvay and Dupont facilities. One well sample and duplicate was collected August 4, 2016, and additional well samples were collected on April 20, 2017 and December 7, 2017.

We do not interpret exposure or risk from the values presented in this report. EPA does not currently have health-based standards, toxicity factors, or associated risk levels for per- or poly-fluorinated alkyl substances (PFAS), other than perfluorooctanoic acid (PFOA) and perfluoroocatane sulfonate (PFOS). While the data provided indicate the presence of certain PFAS in water samples, we do not offer interpretation as to human or environmental exposure or risk from these data.

Thank you for providing us with this opportunity for collaboration that helps to further both EPA's and New Jersey's understanding of an important public health issue. If you have any questions or concerns about this report, do not hesitate to contact me at (919) 541-2107 or via email at watkins.tim@epa.gov or Tim Buckley at (919) 541-2454 or via email at buckley.timothy@epa.gov. I look forward to our continued work together.

Sincerely,

Timothy H. Watkins
Director

Enclosure

CC:

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Detection, Evaluation, and Assignment of PFAS in Environmental Media from an Industrialized Area of New Jersey

Laboratory Data Report #3: Targeted Analysis of PFAS in Water Samples

Background. This report stems from a collaborative study with EPA ORD, EPA Region 2, and NJ DEP entitled "Detection, Evaluation, and Assignment of Multiple Poly- and Perfluoroalkyl Substances (PFAS) in Environmental Media from an Industrialized Area of New Jersey." NJ DEP assumed responsibility for the collection of samples and their shipment to the ORD laboratory. ORD was responsible for sample extraction and analysis of PFAS. ORD's analysis and support team that contributed to this effort are listed in Table 1.

Table 1. EPA Office of Research and Development Analysis and Report Team.

Responsibility	Personnel
ORD Principal Investigators	Andy Lindstrom, Mark Strynar, and John Washington
Laboratory Chemistry	Mark Strynar, James McCord, Seth Newton
Quality Assurance Review	Sania Tong Argao, James Noel
Management Coordination and Review	Myriam Medina-Vera, Tim Buckley
Report Preparation	Kate Sullivan, Tim Buckley

This 3rd report includes targeted analysis results for 57 water samples and 25 field quality control samples including duplicates, spiked blanks, trip blanks, and field blanks. Samples were primarily collected by NJ DEP from October 17, 2017 to December 7, 2017 and were delivered to the ORD lab in Research Triangle Park, NC on several dates between November 3, 2017 and December 15, 2017. One well sample plus duplicate was received by ORD in 2016 and samples from several wells were received in March 2018. The results provided in this report were analyzed under the direction of Dr. Mark Strynar.

The current data report is intended to provide a simple representation and summary of the analysis results. Therefore, the description of methods and quality assurance are brief and high-level. Additional reports and/or publications are being developed that will include a more detailed description of methods, quality assurance analyses, and statistical/geospatial interpretation of the data. As study partners/collaborators, we anticipate that NJ DEP and EPA Region 2 scientists will assist in these additional reports and publications.

Methods

Ten PFAS compounds listed in Table 2 were analyzed with ultra-performance liquid chromatography mass spectrometry (UPLC-MS) using methods described within our Quality Assurance Project Plan (QAPP)[1]. These analytes were selected because previous reports have shown them to be of concern. PFAS concentrations were determined using standards so that quantitation was achieved by a traditional targeted analysis approach. These analyses were performed on samples, process blanks, check standards, and field quality control samples. Samples were not diluted.

Table 2. PFAS Analyzed in NJ Water Samples by UPLC-MS.

Acronym	Chemical Name	Formula	CAS no.	Monoisotopic Mass (g/mol)
PFBA	Perfluorobutanoic Acid	$C_4HF_7O_2$	375-22-4	213.9865
PFPeA	Perfluoropentanoic Acid	$C_5HF_9O_2$	2706-90-3	263.9833
PFHxA	Perfluorohexanoic Acid	$C_6HF_{11}O_2$	307-24-4	313.9801
PFHpA	Perfluoroheptanoic Acid	$C_7HF_{13}O_2$	375-85-9	363.9769
PFOA	Perfluorooctanoic Acid	$C_8HF_{15}O_2$	335-67-1	413.9737
PFNA	Perfluorononanoic Acid	$C_9HF_{17}O_2$	375-95-1	463.9705
PFDA	Perfluorodecanoic Acid	$C_{10}HF_{19}O_2$	335-76-2	513.9673
PFBS	Perfluorobutane Sulfonate	$C_4HF_9SO_3$	375-73-5	299.9503
PFHxS	Perfluorohexane Sulfonate	$C_6HF_{13}SO_3$	355-46-4	398.9366
PFOS	Perfluorooctane Sulfonate	$C_8HF_{17}SO_3$	1763-23-1	499.9375

Data were fully quality assured and checked for compliance with laboratory and field related quality control evaluation criteria as specified in the project QAPP. Quality control samples indicated measurements were generally within our quality control specifications. The mean recoveries of spiked blanks (n=9) ranged from 64% (PFBS) to 103% (PFPeA) with an overall mean recovery for spiked blanks of 81%. However, we observed 25 (of 90) instances where the determination of a spike blank concentration fell outside of our ± 30% recovery acceptance criteria. Those 25 instances were distributed across seven of the analytes: PFBA (n=1), PFOA (n=6), PFNA (n=1), PFDA (n=5), PFBS (n=6), PFHxS (n=1), and PFOS (n=5). For PFOS, we observed contamination of unknown origin in one of our 15 ng/L blank spikes (measured at 120 ng/L). This PFOS value was not included in the mean recoveries reported above. Note that for those analytes having multiple instances in which the ± 30% recovery acceptance criteria was exceeded (i.e. PFOA PFDA, PFBS, and PFOS), concentration estimates for these analytes should be interpreted recognizing greater variability and uncertainty. None of our reported concentrations have been corrected or adjusted for recovery.

Quality control samples also included field/trip blanks and duplicates. In the single field blank included with this set of samples, none of the PFAS analytes were detected except PFBS, which

[1] National Exposure Research Laboratory, Quality Assurance Project Plan: Detection, Evaluation and Assignment of Multiple Poly and Per-fluoroalkyl Substances (PFAS) in environmental media from an industrialized area of New Jersey. Prepared for New Jersey Department of Environmental Protection (NJ DEP), September 14, 2017.

was observed at a concentration of 9.9 ng/L. For the five trip blanks, PFAS analytes were found to be below detection with the exception of PFBS and PFOS, which were found at concentrations of 7.4 and 6.1 ng/L, respectively. The analysis of duplicate samples (n=10) resulted in an average relative percent difference of 17% across all analytes.

The sensitivity of our measurements is defined by detection limit and limit of quantitation (LOQ). We define a measurement to be "non-detect (ND)" when there is no peak that can be integrated. When an integrable peak is present but the concentration falls below the calibration curve, we assign a "less than the limit of quantitation (<LOQ)" qualifier. We report concentration values for peaks that exceed our lowest point on the calibration curve that back predicts within ± 30% on every assay (i.e., 5 ng/L except PFOS, which is 10 ng/L).

Summary of Results

PFAS concentration results are provided in Tables 3-5 for the various types of water samples received. Table 3 includes results for 20 samples and 2 duplicates collected from tidal surface waters, labeled PFTSW. Table 4 includes results for 11 samples and 2 duplicates collected from non-tidal surface water, labeled PFNSW. Table 5 contains results for 23 samples and 3 duplicates collected from wells, labeled PFPW. This table also contains results for one well sample (FPPW 001) collected August 4, 2016, one well (PFPPW 002) collected, April 20, 2017, and one labeled PFIND collected December 7, 2017 and their duplicates.

Concentrations across all samples and analytes ranged from below detection to a maximum of 2,290 ng/L (C9, PFIND 026 DUP). Among the samples analyzed across all the water types, at least one PFAS analyte was detected above the LOQ. Concentrations were generally low with 53% of the sample analyte concentrations reported <LOQ. Concentrations above the LOQ were most prevalent for the C5 & C6 carboxylic acids.

Many PFAS in the past were made by the industrial process of electrochemical fluorination (ECF) which leads to branched and linear structures. A second method called telomerization is purported to lead to only linear PFAS structures. Branched and linear PFAS may be chromatographically separated if gradients are sufficient for resolution. If present in a sample, the branched and linear peaks for PFOA, PFNA and PFOS were integrated separately for estimation of percent branched isomers. Table 6 provides the percentage of each well sample that was branched and calculated based on its proportion of total analyte peak area. Table 7 provides the branching percentage for tidal and non-tidal surface water samples.

Table 3. PFAS Concentrations (ng/L) in Tidal Surface Water Samples Determined with Targeted Analysis.

	Carboxylic Acids							*Sulfonates*		
Carbon length	***C4***	***C5***	***C6***	***C7***	***C8***	***C9***	***C10***	***C4***	***C6***	***C8***
NJDEP Sample ID	**PFBA**	**PFPeA**	**PFHxA**	**PFHpA**	**PFOA**	**PFNA**	**PFDA**	**PFBS**	**PFHxS**	**PFOS**
	ng/L	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**
PFTSW 001	5.1	77.0	11.9	16.8	<LOQ	<LOQ	ND	<LOQ	<LOQ	38.4
PFTSW 002	<LOQ	7.0	5.9	<LOQ	<LOQ	7.7	ND	<LOQ	<LOQ	7.2
PFTSW 003	<LOQ	7.1	7.0	<LOQ	<LOQ	30.5	ND	<LOQ	<LOQ	<LOQ
PFTSW 004	<LOQ	6.9	7.2	<LOQ	<LOQ	12.4	ND	<LOQ	<LOQ	<LOQ
PFTSW 005	5.1	9.2	8.6	<LOQ	<LOQ	12.6	ND	<LOQ	<LOQ	6.1
PFTSW 006	5.9	10.0	11.1	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	431 (JC1)
PFTSW 007	10.4	18.0	24.7	6.7	<LOQ	11.5	<LOQ	<LOQ	<LOQ	<LOQ
PFTSW 008	6.6	10.7	9.3	5.8	<LOQ	17.6	<LOQ	<LOQ	<LOQ	<LOQ
PFTSW 009	<LOQ	5.9	10.0	5.0	<LOQ	16.5	ND	5.1	<LOQ	<LOQ
PFTSW 010	ND	6.8	6.1	<LOQ	ND	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
PFTSW DUP2	ND	7.6	6.9	<LOQ	ND	<LOQ	<LOQ	<LOQ	<LOQ	5.3
PFTSW 011	<LOQ	8.2	5.7	<LOQ	ND	<LOQ	<LOQ	<LOQ	<LOQ	8.2
PFTSW 012	ND	5.1	5.3	<LOQ	<LOQ	<LOQ	ND	<LOQ	<LOQ	14.6
PFTSW 013	ND	5.2	6.0	<LOQ	<LOQ	<LOQ	ND	<LOQ	<LOQ	12.9
PFTSW 014	8.3	14.3	16.5	15.4	452 (JC1)	111	<LOQ	7.3	<LOQ	<LOQ
PFTSW 015	ND	5.8	6.3	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	5.3
PFTSW DUP1	ND	5.6	6.4	<LOQ	ND	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
PFTSW 016	<LOQ	5.0	<LOQ	<LOQ	<LOQ	9.1	<LOQ	<LOQ	<LOQ	<LOQ
PFTSW 017	ND	7.0	5.9	<LOQ	ND	<LOQ	ND	<LOQ	<LOQ	<LOQ
PFTSW 018	ND	5.8	6.1	5.9	<LOQ	24.1	<LOQ	<LOQ	<LOQ	<LOQ
PFTSW 019	10.1	15.2	17.5	9.5	15.3	<LOQ	<LOQ	<LOQ	<LOQ	ND
PFTSW 020	10.6	18.6	21.5	7.6	<LOQ	<LOQ	ND	<LOQ	<LOQ	<LOQ
PFTSW TB1 (Trip blank)	ND	ND	ND	ND	ND	ND	ND	<LOQ	<LOQ	6.1 (B2)
PFTSW TB2 (Trip blank)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PFTSW FB1 (Field blank)	ND	ND	ND	<LOQ	ND	ND	ND	9.9 (B2)	<LOQ	ND

ND: Non-detect based on no integratable peak area

<LOQ: Peak observed but less than the limit of quantitation. LOQ = 5 ng/L, except PFOA =10 ng/L

JC1: Sample result exceeds the upper calibration range

B2: Concentration in blank exceeds LOQ

Table 4. PFAS Concentrations (ng/L) in Non-Tidal Surface Water Samples Determined with Targeted Analysis.

	Carboxylic Acids							*Sulfonates*		
Carbon length	***C4***	***C5***	***C6***	***C7***	***C8***	***C9***	***C10***	***C4***	***C6***	***C8***
NJDEP Sample ID	**PFBA**	**PFPeA**	**PFHxA**	**PFHpA**	**PFOA**	**PFNA**	**PFDA**	**PFBS**	**PFHxS**	**PFOS**
	ng/L	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**
PFNSW 003	5.4	5.1	<LOQ	<LOQ	<LOQ	<LOQ	ND	<LOQ	9.0	27.4
PFNSW 004	5.6	11.2	7.2	<LOQ	ND	<LOQ	ND	<LOQ	<LOQ	<LOQ
PFNSW DUP2	<LOQ	9.0	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
PFNSW 005	<LOQ	<LOQ	<LOQ	5.4	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
PFNSW 012	5.9	5.8	7.2	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	13.4
PFNSW 014	8.4	6.0	5.7	5.1	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	69.2
PFNSW 017	16.2	21.0	27.9	12.7	20.4	14.2	44.6	ND	ND	8.4
PFNSW 018	15.7	25.8	28.3	9.3	<LOQ	<LOQ	ND	10.2	49.3	100
PFNSW DUP1	14.4	25.6	28.8	10.9	<LOQ	<LOQ	<LOQ	11.7	50.6	93.7
PFNSW 019	ND	<LOQ	8.1	7.6	14.7	50.1	5.2	<LOQ	12.0	25.7
PFNSW 020	7.1	5.8	7.8	<LOQ	<LOQ	6.0	ND	<LOQ	<LOQ	<LOQ
PFNSW 023	8.3	12.0	13.5	5.4	<LOQ	19.0	<LOQ	<LOQ	<LOQ	<LOQ
PFNSW 025	15.7	28.8	30.6	17.9	21.9	9.8	<LOQ	<LOQ	<LOQ	6.3
PFNSW TB1 (Trip Blank)	ND	ND	ND	<LOQ	ND	ND	ND	<LOQ	<LOQ	ND

ND: Non-detect based on no integratable peak area

JC1: Sample result exceeds the upper calibration range

<LOQ: Peak observed but less than the limit of quantitation (<LOQ). LOQ = 5 ng/L, except PFOA =10 ng/L.

Table 5. PFAS Concentrations (ng/L) in Well Water Samples Determined with Targeted Analysis.

	Carboxylic Acids							*Sulfonates*		
Carbon length	***C4***	***C5***	***C6***	***C7***	***C8***	***C9***	***C10***	***C4***	***C6***	***C8***
NJDEP Sample ID	**PFBA**	**PFPeA**	**PFHxA**	**PFHpA**	**PFOA**	**PFNA**	**PFDA**	**PFBS**	**PFHxS**	**PFOS**
	ng/L	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**
PFPW 002	ND	ND	<LOQ	10.3	<LOQ	89.6	<LOQ	<LOQ	<LOQ	ND
PFPW 003	156	ND	309 (JC1)	174	285 (JC1)	66.6	8.2	<LOQ	16.9	91.3
PFPW 004	51.1	77.6	91.7	33.5	45.3	11.4	ND	<LOQ	<LOQ	<LOQ
PFPW 005	<LOQ	7.2	6.9	6.0	<LOQ	19.0	ND	<LOQ	<LOQ	5.7
PFPW 007	12.1	20.0	32.8	25.1	104	19.0	ND	<LOQ	<LOQ	5.2
PFPW 008	8.7	19.8	23.8	11.5	47.5	161	<LOQ	<LOQ	<LOQ	5.0
Dup	22.2	15.0	27.8	9.9	47.1	123	<LOQ	<LOQ	<LOQ	10.2
PFPW 009	ND	5.0	5.6	<LOQ	<LOQ	8.2	ND	ND	<LOQ	ND
PFPW 010	ND	<LOQ	<LOQ	7.3	<LOQ	37.4	ND	<LOQ	<LOQ	ND
PFPW DUP2	23.0	<LOQ	<LOQ	9.5	<LOQ	40.8	ND	<LOQ	ND	ND
PFPW 011	<LOQ	<LOQ	5.2	16.7	57.7	ND	<LOQ	6.1	6.0	8.1
PFPW 012	<LOQ	5.5	8.4	25.2	10.4	12.3	<LOQ	<LOQ	<LOQ	<LOQ
PFPW DUP1	14.7	7.1	8.6	6.3	<LOQ	10.5	<LOQ	<LOQ	<LOQ	<LOQ
PFPW 013D	ND	ND	ND	<LOQ	ND	<LOQ	ND	<LOQ	<LOQ	ND
PFPW 013I	ND	ND	<LOQ	<LOQ	ND	<LOQ	ND	<LOQ	<LOQ	<LOQ
PFPW 013S	<LOQ	<LOQ	8.5	6.9	13.5	42.1	<LOQ	<LOQ	10.1	27.7
PFPW 014	ND	<LOQ	5.6	5.4	ND	32.0	ND	ND	<LOQ	<LOQ
PFPW 015	ND	6.7	7.3	43.6	11.6	53.4	ND	ND	<LOQ	<LOQ
PFPW 016	ND	ND	ND	<LOQ	ND	<LOQ	ND	ND	ND	ND
PFPW 017	<LOQ	8.1	<LOQ	5.1	26.5	176	<LOQ	6.1	<LOQ	14.7
PFPW 019	20.2	39.2	43.1	28.2	85.9	38.6	<LOQ	<LOQ	<LOQ	246 (JC1)
PFPW 020	6.3	8.6	6.4	5.0	<LOQ	37.3	<LOQ	<LOQ	<LOQ	10.5
PFPW 021	15.4	38.4	61.5	38.4	74.9	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
PFPW 022	71.8	ND	514 (JC1)	236 (JC1)	451 (JC1)	10.6	ND	<LOQ	<LOQ	6.1
PFPW 024	72.7	ND	265 (JC1)	180	339 (JC1)	34.7	<LOQ	10.4	7.4	6.9
PFPW 025	16.5	37.9	48.5	23.9	44.7	11.8	<LOQ	<LOQ	<LOQ	12.1
FPPW 001	<LOQ	11.3	10.8	70.5	1,240 (JC1)	1,170 (JC1)	ND	<LOQ	<LOQ	ND
FPPW 001DUP	<LOQ	11.5	11.8	74.8	1,320 (JC1)	1,270 (JC1)	ND	13.1	ND	ND

ND: Non-detect based on no integratable peak area

JC1: Sample result exceeds the upper calibration range

<LOQ: Peak observed but less than the limit of quantitation. LOQ = 5 ng/L, except PFOA =10 ng/L.

B2: Concentration in blank exceeds LOQ

Table 5. PFAS Concentrations (ng/L) in Well Water Samples Determined with Targeted Analysis. (continued)

	Carboxylic Acids							*Sulfonates*		
Carbon length	***C4***	***C5***	***C6***	***C7***	***C8***	***C9***	***C10***	***C4***	***C6***	***C8***
NJDEP Sample ID	**PFBA**	**PFPeA**	**PFHxA**	**PFHpA**	**PFOA**	**PFNA**	**PFDA**	**PFBS**	**PFHxS**	**PFOS**
	ng/L	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**
PFPPW 002	9.5	11.2	12.2	9.9	31.9	126	<LOQ	<LOQ	<LOQ	6.4
PFPPW 002DUP	8.1	13.5	14.4	14.5	36.9	137	<LOQ	<LOQ	5.0	8.2
PFIND 026	97.2	26.5	19.7	46.7	615 (JC1)	2,220 (JC1)	5.1	<LOQ	5.5	17.1
PFIND 026DUP	97.2	23.5	21.8	48.1	607 (JC1)	2,290 (JC1)	5.7	<LOQ	5.8	10.8
PFPW TB1 (Trip Blank)	ND	ND	ND	<LOQ	ND	<LOQ	ND	ND	ND	ND
PFPW TB2 (Trip Blank)	<LOQ	<LOQ	<LOQ	<LOQ	ND	<LOQ	ND	7.4 (B2)	ND	ND

ND: Non-detect based on no integratable peak area

JC1: Sample result exceeds the upper calibration range

<LOQ: Peak observed but less than the limit of quantitation. LOQ = 5 ng/L, except PFOA =10 ng/L.

B2: Concentration in blank exceeds LOQ

Table 6. Percent (%) Branching for PFOA, PFNA and PFOS in well samples based on peak area.

		PFOA LOQ<10		PFNA LOQ<5		PFOS LOQ<5	
Sample Type	Sample ID	Total PFOA (ng/L)	% Branched*	Total PFNA (ng/L)	% Branched*	Total PFOS (ng/L)	% Branched*
Wells	PFPW 002	<LOQ	11	89.6	2	ND	NA
	PFPW 003	285 (JC1)	11	66.6	17	91.3	31
	PFPW 004	45.3	6	11.4	3	<LOQ	19
	PFPW 005	<LOQ	13	19.0	0	5.7	6
	PFPW 007	104	6	19.0	0	5.2	42
	PFPW 008	47.5	9	161	0	5.0	19
	Dup	47.1	8	123	50	10.2	7
	PFPW 009	<LOQ	15	8.2	0	ND	NA
	PFPW 010	<LOQ	7	37.4	0	ND	NA
	PFPW DUP2	<LOQ	6	40.8	0	ND	NA
	PFPW 011	57.7	15	ND	NA	8.1	32
	PFPW 012	10.4	8	12.3	0	<LOQ	0
	PFPW DUP1	<LOQ	9	10.5	0	<LOQ	0
	PFPW 014	ND	NA	32.0	0	<LOQ	42
	PFPW 015	11.6	6	53.4	0	<LOQ	0
	PFPW 016	ND	NA	<LOQ	0	ND	NA
	PFPW 017	26.5	27	176	0	14.7	30
	PFPW 019	85.9	8	38.6	3	246 (JC1)	16
	PFPW 020	<LOQ	9	37.3	0	10.5	22
	PFPW 021	74.9	6	<LOQ	23	<LOQ	0
	PFPW 022	451 (JC1)	5	10.6	3	6.1	42
	PFPW 024	339 (JC1)	5	34.7	3	6.9	34
	PFPW 025	44.7	4	11.8	0	12.1	9
	PFPW 013D	ND	NA	<LOQ	40	ND	NA
	PFPW 013I	ND	NA	<LOQ	0	<LOQ	0
	PFPW 013S	13.5	4	42.1	0	27.7	14
	PFPPW 002	31.9	15	126	0	6.4	28
	PFPPW 002DUP	36.9	8	137	0	8.2	30
	FPPW 001	1,240 (JC1)	23	1,170 (JC1)	0	ND	NA
	FPPW 001DUP	1,320 (JC1)	24	1,270 (JC1)	0	ND	NA
	PFIND 026	615 (JC1)	12	2,220 (JC1)	0	17.1	25
	PFIND 026DUP	607 (JC1)	14	2,290 (JC1)	0	10.8	32

* Percent branched is based on analyte peak area counts
ND: Non-detect based on no integratable peak area
<LOQ: Peak observed but less than the limit of quantitation: LOQ = 5 ng/L, except PFOA =10 ng/L
JC1: Sample result exceeds the upper calibration range
NA: Sample concentration is ND, branching not determined

Table 7. Percent (%) Branching for PFOA, PFNA and PFOS analytes in tidal and non-tidal surface water samples based on peak area.

		PFOA LOQ<10		PFNA LOQ<5		PFOS LOQ<5	
Sample Type	Sample ID	Total PFOA (ng/L)	% Branched*	Total PFNA (ng/L)	% Branched*	Total PFOS (ng/L)	% Branched*
Tidal Surface Water	PFTSW 001	<LOQ	20	<LOQ	0	38.4	15
	PFTSW 002	<LOQ	27	7.7	5	7.2	14
	PFTSW 003	<LOQ	35	30.5	2	<LOQ	0
	PFTSW 004	<LOQ	35	12.4	6	<LOQ	0
	PFTSW 005	<LOQ	15	12.6	4	6.1	10
	PFTSW 006	<LOQ	12	<LOQ	0	431 (JC1)	6
	PFTSW 007	<LOQ	11	11.5	3	<LOQ	9
	PFTSW 008	<LOQ	10	17.6	0	<LOQ	0
	PFTSW 009	<LOQ	9	16.5	0	<LOQ	0
	PFTSW 010	ND	NA	<LOQ	0	<LOQ	15
	PFTSW DUP2	ND	NA	<LOQ	0	5.3	17
	PFTSW 011	ND	NA	<LOQ	0	8.2	15
	PFTSW 012	<LOQ	10	<LOQ	0	14.6	10
	PFTSW 013	<LOQ	11	<LOQ	0	12.9	16
	PFTSW 014	452 (JC1)	10	111	0	<LOQ	14
	PFTSW 015	<LOQ	24	<LOQ	4	5.3	20
	PFTSW DUP1	ND	NA	<LOQ	0	<LOQ	0
	PFTSW 016	<LOQ	7	9.1	0	<LOQ	27
	PFTSW 017	ND	NA	<LOQ	0	<LOQ	20
	PFTSW 018	<LOQ	9	24.1	0	<LOQ	31
	PFTSW 019	15.3	8	<LOQ	0	ND	NA
	PFTSW 020	<LOQ	9	<LOQ	0	<LOQ	14
Non-tidal Surface Water	PFNSW 003	<LOQ	14	<LOQ	0	27.4	20
	PFNSW 004	ND	NA	<LOQ	0	<LOQ	28
	PFNSW DUP2	<LOQ	9	<LOQ	0	<LOQ	0
	PFNSW 005	<LOQ	11	<LOQ	0	<LOQ	0
	PFNSW 012	<LOQ	11	<LOQ	0	13.4	36
	PFNSW 014	<LOQ	5	<LOQ	0	69.2	9
	PFNSW 017	20.4	5	14.2	0	8.4	0
	PFNSW 025	21.9	7	9.8	0	6.3	14
	PFNSW 018	<LOQ	10	<LOQ	0	100	24
	PFNSW DUP1	<LOQ	16	<LOQ	0	93.7	24
	PFNSW 019	14.7	0	50.1	0	25.7	14
	PFNSW 020	<LOQ	4	6.0	0	<LOQ	31
	PFNSW 023	<LOQ	10	19.0	0	<LOQ	15

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NA: Sample concentration is ND, branching not determined